Climate Model Diagnostic Analyzer (CMDA)

Completed Technology Project (2015 - 2017)

Project Introduction

Both the National Research Council (NRC) Decadal Survey and the latest Intergovernmental Panel on Climate Change (IPCC) Assessment Report stressed the need for the comprehensive and innovative evaluation of climate models with the synergistic use of global observations in order to maximize the investments made in Earth observational systems and also to capitalize on them for improving our weather and climate simulation and prediction capabilities. The abundance of satellite observations for fundamental climate parameters and the availability of coordinated model outputs from the Coupled Model Intercomparison Project Phase 5 (CMIP5) for the same parameters offer a great opportunity to understand and diagnose model biases in climate models. In addition, the Obs4MIPs efforts have created several key global observational datasets that are readily usable for model evaluations. We propose to develop a novel methodology to diagnose model biases in contemporary climate models and to implement the methodology as a web-service based, cloud-enabled, provenance-supported climate-model evaluation system for the Earth science modeling and model analysis community. The proposed information system is named Climate Model Diagnostic Analyzer (CMDA) and will be built upon the current version of CMDA, which is the product of the research and technology development investments of several current and past NASA ROSES programs led by the proposal team members. We will leverage the current technologies and infrastructure of CMDA and extend the capabilities of CMDA to address several technical challenges that the modeling and model analysis community faces in evaluating climate models by utilizing three technology components: (1) diagnostic analysis methodology; (2) web-service based, cloud-enabled technology; (3) provenance-supported technology. The proposed diagnostic analysis methodology will help the scientists identify the physical processes responsible for creating model biases and incorporate the understanding into new model representations that reduce the model biases. Potentially, the results of the proposed work can significantly increase the model predictability of climate change because improving the model representations of the current climate system is essential to enhancing confidence in seasonal, decadal, and long-term climate projections. Additionally, the proposed web-service based, cloud-enabled technology will facilitate a community-wide use and relatively effortless adoption of this novel model-diagnosis methodology. Its web-browser interface and cloud-based computing will allow instantaneous use without the hassle of local installation, compatibility issues, and scalable computational resource issues and offer a low barrier to the adoption of the tool. Finally, the proposed provenance-supported technology will automatically keep track of processing history during analysis calls, represent the summary of the processing history in a human readable way, and enable provenance-based search capabilities. Scientists currently spend a large portion of their research time on searching previously analyzed results and regenerating the same results when they fail to locate them. The reproducibility of the analysis results by other scientists is also limited for the same reason. The proposed

Climate Model Diagnostic Analyzer

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Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

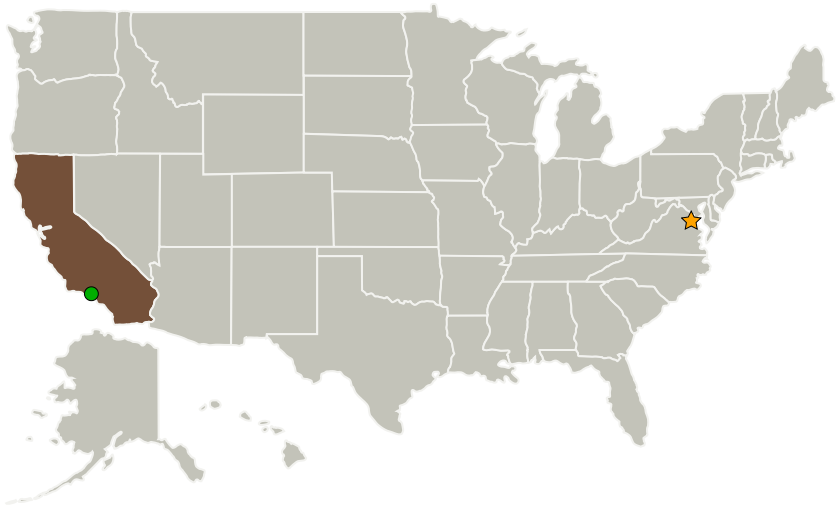
NASA Headquarters (HQ)

Responsible Program:

Advanced Information Systems Technology

provenance support technology will greatly improve the productivity of the scientists using the analysis tool and enable scientists to share/reproduce the results generated by other scientists.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★NASA Headquarters(HQ)	Lead Organization	NASA Center	Washington, District of Columbia
●Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Management

Program Director:

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Co-Investigators:

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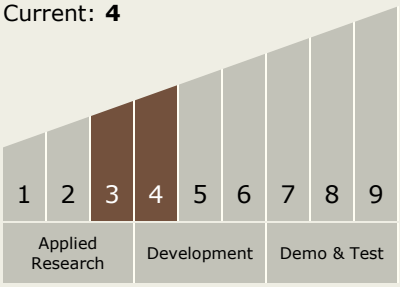
Mark W Powell
Terence L Kubar
Joao Teixeira
Lei Pan
Chengxing Zhai
Benyang Tang
Jonathan H Jiang
Jui-lin F Li

Technology Maturity (TRL)

Start: **3**
Current: **4**



Technology Areas

Primary:

Continued on following page.

Technology Areas *(cont.)*

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.2 Modeling
    - TX11.2.4 Science Modeling

Target Destination

Earth